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[0291] In order to acquire an accurate position of the docking station **300**, the robot cleaner **100** may assume that a time when the robot cleaner **100** is moved from a position of (t+1) is moved to another position, is (t+2), and a straight line straightly connecting the robot cleaner **100** to a position of (t+2) to a direction in which an infrared signal of the docking station **300** is detected is (f3).

[0292] In order to acquire position information (x, y, θ°) of the docking station **300**, the controller **110** of the robot cleaner **100** may calculate a straight line equation (f1, f2, f3) by using a relationship between three variables and three position information since the controller **110** of the robot cleaner **100** acquires position information, which is position information in at (t), position information in at (t+1) and position information in at (t+2), that is measured via the position detector **150**.

[0293] Therefore, the robot cleaner **100** may determine a cross point (c1) of the calculated straight line equation (f1, f2, f3), which is calculated according to the above mentioned method, as a position of the docking station **300**.

[0294] However, in this case, it may be possible to acquire a cross point by displaying three straight line equations, but the controller **110** of the robot cleaner **100** may acquire a position of the docking station **300** with two position information by using the triangulation. That is, a distance between two position information, and two direction angles from two position information to a direction of the docking station **300** may be acquired and thus a position of the docking station **300** may be acquired by using the triangulation.

[0295] Referring to FIG. **16**, the probability based method may represent a method to acquire a position of the docking station **300** such that when the robot cleaner **100** detects an infrared output signal of the docking station **300** via the signal detector **190**, the robot cleaner **100** filters an infrared output signal of the docking station **300** by using a probability based filtering method including Bayes filter, while moving a plurality of points, via the controller **110**, so as to estimate a direction of an infrared output signal thereby acquiring a position of the docking station **300**.

[0296] Hereinafter the probability based filtering method may represent a method for estimating a position of the docking station **300** by the robot cleaner **100** based on Bayes' theorem. Bayes' theorem is a method to calculate the posterior probability by using Likelihood function and prior probability, and according to an embodiment, the robot cleaner **100** may estimate a position of the docking station **300** by filtering an infrared output signal of the docking station **300** according to the probability based filtering method including Bayes filter.

[0297] Bayes filter may include Gaussian Filter and Nonparametric Filter. Particularly, Gaussian Filter is a method to represent a probability distribution with Gaussian mean and variance parameters, and Gaussian Filter may be a concept including Kalman Filter, Extended Kalman filter (EKF), Unscented Kalman filter (UKF), and Information filter. Nonparametric Filter is a method to represent a probability distribution with finite sample, and Nonparametric Filter may be a concept including Histogram Filter and Particle Filter.

[0298] Particle filter technique is one of the simulation method based on trial and error, and is referred to as Sequential Monte Carlo method (SMC). Monte Carlo Method is one of method for calculating the value of the

function stochastically by collecting random input result of a sufficient number. Monte Carlo method may acquire the characteristics of the system by stochastically calculating the value of the function.

[0299] The controller **110** of the robot cleaner **100** may employ the probability based filtering method to measure an infrared output signal of the docking station **300** at a plurality of points so as to generate a probabilistic model about a candidate position of the docking station **300** (hereinafter referred to as "particle") thereby acquiring a position of the docking station **300** with the probability distribution.

[0300] Particularly, when the controller **110** of the controller **110** detects an infrared output signal of the docking station **300** via the signal detector **190** during the robot cleaner **100** drives, the controller **110** of the robot cleaner **100** may identify an infrared receiver in which the infrared output signal is detected and distribute a particle to the direction of the infrared receiver.

[0301] However, when entire of the robot cleaner **100** is placed in the infrared output signal region, the controller **110** of the robot cleaner **100** may distribute a particle toward all directions since all of infrared receivers detect an infrared output signal.

[0302] The controller **110** of the robot cleaner **100** may perform a sampling. That is, the controller **110** of the robot cleaner **100** may extract a plurality of samples having an estimated value of a position of the docking station **300** so as to acquire a position of the docking station **300** by using a possibility in which each sample is an actual position of the docking station **300**.

[0303] Particularly, the controller **110** of the robot cleaner **100** may apply a weight to a particle in a direction in which an infrared output signal of the docking station **300** is detected among the plurality of samples. And then the controller **110** may re-select particles based on the weight to remove a particle having a low possibility to be a position of the docking station **300** besides a particle having a high possibility to be a position of the docking station **300**.

[0304] This process repeated in a plurality of points will be described with reference to FIG. **16**.

[0305] FIG. **16** illustrates a distribution of a direction in which an infrared output signal of the docking station **300** is detected during the robot cleaner **100** drives, on a plane surface.

[0306] Referring to a lower picture of FIG. **16**, the left infrared receiver **191***b* of the robot cleaner **100** may detect an infrared output signal of the docking station **300**.

[0307] When the controller **110** of the robot cleaner **100** assumes that a moving direction of the robot cleaner **100** is north, it may be assumed that a direction in which an infrared output signal of the docking station **300** is detected is north-west side. Therefore, the controller **110** may distribute a particle (P) to north-west side.

[0308] The controller **110** of the robot cleaner **100** may remove a particle (P) representing a direction having a low possibility of placing the docking station **300**, through the sampling. In addition, the controller **110** of the robot cleaner **100** may perform resampling in the way of maintaining a particle (P) representing a direction having a high possibility of placing the docking station **300**.

[0309] Referring to an upper picture of FIG. **16**, the left infrared receiver **191***b* of the robot cleaner **100** may detect an infrared output signal of the docking station **300**.